

REMARKS

In response to the office action dated April 16, 2008, Applicants have amended claims 4, 7, 10, 12, 19, and 24, and cancelled claims 11 and 21. Claims 1-10, 12-20, and 22-24 are presented for examination.

The Examiner objected to claims 4 and 7 on the ground that they contain informalities. Applicants amended these two claims to obviate these objections, so the objections should be withdrawn.

The Examiner rejected claims 10-11, 13-15, 19, 20, 22, and 24 as being anticipated by Sentein et al., Optical Materials, 9 (1998) 316-322 ("Sentein").

Applicants cancelled claim 11, so the rejection against claim 11 should be withdrawn.

Claims 10 and 13-15, as amended, cover methods of treating a photovoltaic cell having two compounds, i.e., an electron donor (e.g., a conjugated polymer) and an electron acceptor (e.g., a fullerene) in a photoactive layer. By contrast, Sentein describes placing a diode-like polymer containing both a donor and an acceptor between two electrodes and applying a static electric field through the polymer while heating near the glass transition temperature. *See*, e.g., section 1, last paragraph and section 2, 1st paragraph. Sentein does not disclose a device containing a photoactive layer that has an electron donor and an electron acceptor as two separate compounds, as required by amended claims 10 and 13-15. Thus, amended claims 10 and 13-15 are not anticipated by Sentein.

Claims 19, 20, 22, and 24, as amended, cover methods of treating a photovoltaic cell, in which the photovoltaic cell is heated to above a glass transition temperature (T_g) of an electron donor. By contrast, Sentein describes heating its device below the T_g of the diode-like polymer between the two electrodes. Specifically, Sentein indicates that its device was heated at 130°C, 2°C less than the T_g of the diode-like polymer, i.e., 132°C. *See* section 2, 1st and 3rd paragraphs. Thus, amended claims 19, 20, 22, and 24 are not anticipated by Sentein.

Accordingly, Applicants request reconsideration and withdrawal of this rejection.

The Examiner rejected claims 1-9 as being obvious over Cravino et al., J. Mater. Chem., 2002, 12, 1931-1943 ("Cravino") in view of Sentein and Zhao et al., Polymer, 1995, 36(11), 2211-2214 ("Zhao").

Claims 1-9 cover methods of treating a photovoltaic cell having a conjugated polymer component and a fullerene component in a photoactive layer. During the treatment, the photovoltaic cell is subjected to heat treatment above a T_g of the conjugated polymer for a predetermined treatment time, the heat treatment of the photovoltaic cell being carried out for at least a portion of the treatment time under the influence of an electric field

Cravino describes a photovoltaic cell containing a conjugated polymer and a fullerene in a photoactive layer. *See*, e.g., section 1. However, as correctly pointed out by the Examiner, Cravino is silent on subjecting the photovoltaic cell to a heat treatment above a T_g of the conjugated polymer or subjecting the photovoltaic cell to an electric field for at least a portion of the treatment time, as required by claims 1-9.

Sentein does not cure the deficiency in Cravino. As discussed above, Sentein describes a device containing a diode-like polymer between the two electrodes. In other words, the layer between the two electrodes in the device described in Sentein only contains one component. Sentein does not disclose or suggest a photovoltaic cell containing two components (i.e., a conjugated polymer component and a fullerene component) in a photoactive layer, as required by claims 1-9. Indeed, Sentein teaches using a one-component polymer photoactive layer to replace a two-component p-n junction photoactive layer. It states that:

“However, p-n junctions require the use of two polymer layers bearing wet-processing compatibility. Moreover n-type organic semiconductors are less common than p-ones owing to their lower stability under oxygen, ... We hereby propose an alternative interdisciplinary principle derived from the application of nonlinear optical techniques to the polymeric semiconductors. ... In addition to the ease of processing of such devices, our solution offers a crucial advantage over usual p-n-junctions. Indeed, the efficiency of organic-semiconductor p-n-junction devices is usually limited by the weak extension of the depletion zone (typically 10 to 50 nm) ..., in which the majority of charge separation or recombination processes take place. Our solution provides a depletion zone extending over the whole polymer film thickness.” *See* section 1, 1st and 2nd paragraphs and section 5, 1st paragraph.

Thus, because Sentein teaches that a one-component polymer photoactive layer offers a crucial advantage over a two-component p-n junction photoactive layer, it would not have been obvious for one skilled in the art to replace the two-component p-n junction photoactive layer described in Cravino with the one-component polymer photoactive layer described in Sentein. Further, as

discussed above, Sentein describes heating its device below the Tg of the diode-like polymer, not above the Tg of a conjugated polymer as required by claims 1-9. Thus, even if Sentein were combined with Cravino, the results would still not be the methods of claims 1-9.

Zhao does not cure the deficiencies in Cravino or Sentein either. Zhao describes studying the phase transitions of poly(3-hexylthiophene) by Differential Scanning Calorimetry (DSC). See, e.g., the abstract. However, Zhao does not disclose or even suggest a photovoltaic cell, let alone heating a photovoltaic cell above the Tg of the conjugated polymer in photoactive layer while applying an electric field simultaneously, as required by claims 1-9. The Examiner asserts that

“[i]t would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Cravino and Sentein by increasing the heating temperature to above the Tg of the conjugated polymer as taught by Zhao because a higher crystallization can be obtained at higher crystallization temperatures, as taught by Zhao. Higher crystallization as a result of rectification of the polymer molecule reduces potential barriers for extraction of electricity at the electrode, as taught by Sentein (Section 5, ¶ 1).” See the office action, page 6, 3rd paragraph.

Applicants disagree. Zhao at most discloses that a higher crystallization temperature can be obtained by a fast crystallization process, not by heating at a higher temperature as asserted by the Examiner. Indeed, Zhao states that “[w]e found two well separated crystal formation process: a fast process, ..., which produces crystals having higher transition temperature, ... and a slow process which leads to continuous growth of less stable crystals.” See, e.g., the abstract, emphases added. Further, nothing in section 5, ¶ 1 of Sentein teaches “[h]igher crystallization as a result of rectification of the polymer molecule reduces potential barriers for extraction of electricity at the electrode” as asserted by the Examiner. Indeed, nothing in that paragraph of Sentein teaches that rectification of polymer molecules would result in higher crystallization or that higher crystallization would reduce potential barriers for extraction of electricity.

In sum, it would not have been obvious for one skilled in the art to combine Cravino, Sentein, and Zhao to provide the methods of claims 1-9. Even if Cravino, Sentein, and Zhao were combined, the result would still not be the methods of claims 1-9.

For at least the reasons set forth above, claim 1-9 are not obvious over Cravino in view of Sentein and Zhao. Accordingly, Applicants request reconsideration and withdrawal of the rejection.

The Examiner rejected claims 12 and 21 as being obvious over Sentein in view of Zhao.

Applicants cancelled claim 21, so the rejection of this claim should be withdrawn. Claim 12 covers methods of treating a photovoltaic cell containing two compounds in a photoactive layer. During the treatment, the photovoltaic cell is heated to above a Tg of an electron donor. As discussed above, neither Sentein nor Zhao discloses or suggests such methods. Thus, it would not have been obvious for one skilled in the art to combine Sentein and Zhao to provide the methods of claim 12. Even if Sentein and Zhao were combined, the result would still not be the methods of claim 12. Thus, claim 12 is not obvious over Sentein in view of Zhao. Accordingly, Applicants request reconsideration and withdrawal of this rejection.

The Examiner rejected 16-18 and 23 as being obvious over Sentein. Claims 16-18 cover methods of treating a photovoltaic cell containing two compounds in a photoactive layer. Claim 23 covers methods of treating a photovoltaic cell, in which the photovoltaic cell is heated to above a Tg of an electron donor. As discussed above, Sentein does not disclose or even suggest such methods. Thus, claims 16-18 and 23 are not obvious over Sentein. Accordingly, Applicants request reconsideration and withdrawal of this rejection.

Applicants submit that the pending claims are now in condition for allowance, an action of which is requested.

Please apply charges, if any, to deposit account 06-1050, referencing Attorney's Docket No. 21848-003US1.

Respectfully submitted,

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